Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Block \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Binder \_\_\_\_\_\_\_\_\_

**Fill in the Blank Notes - #1-5**

1. **Astronomy** – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. **Geocentric** – E\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is at the center of the U\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_;

Sun, P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, Moon, S\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ rotate around the Earth

\*Stars rotate on the O\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a hollow S\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\*\_\_\_\_\_\_\_\_\_ wanderers inside the sphere: Sun, M\_\_\_\_\_\_\_\_\_\_\_\_\_\_, Mercury, V\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_,

Mars, J\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, Saturn

3. Geocentric View – Ancient Greeks

**Aristotle** believed this.

**Erotosthenes** – around 2000 BC

\*Calculated the S\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the E\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ within \_\_\_\_\_\_% of true size

4. Geocentric View – Ancient Greeks

**Ptolemy** – AD 141

\*Created theory of E\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to explain Retrograde M\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\*C\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ C\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ adopted Ptolemaic Astronomy

5. **Retrograde Motion**

Def – The apparent W\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ motion of P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ with respect to

S\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Planets seemed to M\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ B\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at times

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Block \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Binder \_\_\_\_\_\_\_\_\_

**Fill in the Blank Notes - #6-9**

6. **Heliocentric – Copernicus**

C\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (1473-1543) proposed H\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ view

\*Believed the Earth R\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\*Believed in C\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ orbits (N\_\_\_\_\_\_\_\_\_\_\_\_ T\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)

\*Catholic Church considered him a H\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

7. **Heliocentric**

Def – E\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, moon, P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and E\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ else orbit

The sun

\*Is this True? Why or why not? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

8. **Revolution**

Def – M\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a B\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ along a P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

around some P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in S\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Draw:**

\*Earth R\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ around the S\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

It takes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for the earth to revolve around the sun.

\*M\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ revolves around the E\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

It takes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for the moon to revolve around the Earth.

9. **Rotation**

Def – the T\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ / S\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a body on it’s A\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Draw:**

Earth rotates on it’s axis 1 time in \_\_\_\_\_\_\_\_\_\_\_\_ hours (creating our D\_\_\_\_\_\_\_\_ / N\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Block \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Binder \_\_\_\_\_\_\_\_\_

**Fill in the Blank Notes - #10-12**

10. **Heliocentric – Tycho Brahe (1564-1601)**

-Extremely A\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ M\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of stars and P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-Rejected Copernican (Heliocentric) View and came up with his own theory

-Detected S\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_,

**Draw:**

11. **Stellar Parallax**

Def-The Apparent slight S\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in basic P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of S\_\_\_\_\_\_\_\_\_\_\_\_\_

due to the E\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ O\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

\*The most basic way to measure stars

-very small angles (1/3600 of a degree)

\*Only useful with C\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ S\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(only about \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ total)

12. Distance to the Stars – example

Demonstration – thumb, right and left eyes

12. Parallax Problems

**1 parsec = 3.26 light years**

1. What is the parallax (0) of a star located 10 parsecs away?

Answer: R = 1 10 = 1 X = 1 X = 0.1 or 0.1”

0 X 10

2. What is the distance of a star with a parallax of 0.04”?

Answer: R = 1 R = 1 R = 25 parsecs

1. 0.04

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Block \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Binder \_\_\_\_\_\_\_\_\_

**Fill in the Blank Notes - #13-18**

13. **Johannes Kepler** – Heliocentric (1571-1630)

-Tycho Brahe’s assistant. Used Brahe’s M\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and D\_\_\_\_\_\_\_.

-Created the \_\_\_\_\_\_ Laws of P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- Motion

14. **3 Laws of Planetary Motion**

-1st Law – Law of E\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-2nd Law – Equal T\_\_\_\_\_\_\_\_\_\_\_\_\_\_, E\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Area

-3rd Law – H\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Law (D\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ relates to T\_\_\_\_\_\_\_\_\_.)

15. **1st Law: Law of Ellipses**

-Def – P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ travel in E\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ orbits with the S\_\_\_\_\_\_\_ at one F\_\_\_\_\_\_\_\_\_\_\_\_\_.

-**Eccentricity** = Distance **between F\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (A)**

Distance from \_\_\_\_ S\_\_\_\_\_\_\_\_\_\_ to O\_\_\_\_\_\_\_\_\_\_\_\_ **(B)**

**-**Drawing of eccentricity …………………………………………………………………….

16. **2nd Law: Equal Area in Equal Time**

**-**Def – Planets S\_\_\_\_\_\_\_\_\_\_\_\_\_\_ through E\_\_\_\_\_\_\_\_\_\_\_\_ areas in Equal T\_\_\_\_\_\_\_\_\_\_\_.

-Planets are F\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ when C\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to the S\_\_\_\_\_\_\_\_\_\_.

**Draw:**

17. **3rd Law: Harmonic Law**

-Def: The F\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the Planet is from the S\_\_\_\_\_\_\_\_\_\_, the L\_\_\_\_\_\_\_\_\_\_\_\_\_\_ it takes to

O\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the S\_\_\_\_\_\_\_\_\_\_\_.

Formula: P2 = A3  P = P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of Orbit (Y\_\_\_\_\_\_\_\_\_\_\_\_\_), A = D\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (AU)

18. **Astronomical Unit (AU)**

-Def: A\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ D\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ between the E\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and S\_\_\_\_\_\_\_\_.

Draw:

1 AU is about \_\_\_\_\_\_\_ million km or about 93 million miles

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Block \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Binder \_\_\_\_\_\_\_\_\_

**Fill in the Blank Notes - #19-24**

19. Heliocentric - **Galileo Galilei (1564-1642)**

**-**First to use S\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ M\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to support his theories

-Built his own T\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from scratch

-C\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ gave L\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ sentence for his views.

-Went B\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from looking at the S\_\_\_\_\_\_\_\_\_\_\_\_\_

20. **Galileo’s 1st discovery**

- \_\_\_\_\_\_\_\_\_ moons of J\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-Ganymede, C\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, Io, E\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

21. **Galileo’s 2nd Discovery**

-P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are C\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ discs, not just P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of L\_\_\_\_\_\_\_\_\_\_\_.

22**. Galileo’s 3rd Discovery**

-v\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ has P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, just like the M\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

23. **Galileo’s 4th Discovery**

-The M\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ surface is N\_\_\_\_\_\_\_\_\_ S\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

24. **Galileo’s 5th Discovery**

-The S\_\_\_\_\_\_\_\_\_\_\_\_\_\_ has D\_\_\_\_\_\_\_\_\_\_ R\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ called S\_\_\_\_\_\_\_\_\_\_\_ S\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Block \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Binder \_\_\_\_\_\_\_\_\_

**Fill in the Blank Notes - #25-34**

25. **Sir Isaac Newton** (1642-1727)

-known as the “G\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ scientist of A\_\_\_\_\_\_\_\_\_\_ T\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

-Inventor of C\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and Classical P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

-Formulated the Law of G\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

-Discovered that W\_\_\_\_\_\_\_\_\_\_\_ Light can be broken into R\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

-Invented the R\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ T\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

-Went B\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from looking at the S\_\_\_\_\_\_\_\_\_.

26. **Newton’s First Law – Inertia**

-A B\_\_\_\_\_\_\_\_\_\_\_\_ remains at R\_\_\_\_\_\_\_\_\_ or in M\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ with a constant V\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

unless acted upon by an O\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ F\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

-If you T\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a ball in S\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, it keeps going on F\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

-Why does an A\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ fall out a T\_\_\_\_\_\_\_\_\_\_\_? Wasn’t it at R\_\_\_\_\_\_\_\_\_\_\_\_\_ in the tree?

27. **Gravity**

Def: The F\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that attracts a B\_\_\_\_\_\_\_\_\_\_ toward the C\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the earth,

S\_\_\_\_\_\_\_, or toward any other P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ body having M\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

28. **Inertia**

Def: E\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ body continues its S\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of Motion or R\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (and

V\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) in the A\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an O\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ force.

29. **Why do planets stay in orbit?**

-Gravity and Inertia work together

**Draw….**

30**. Universal Gravitation**

Def: All O\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the U\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ attract each other

-Gravity is P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to their M\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Larger

M\_\_\_\_\_\_\_\_\_\_, larger f\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of Attraction.)

-Inversely proportional to the S\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the D\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

1 km apart = **1**, 3 km apart = **32**, or \_\_\_\_ times less F\_\_\_\_\_\_\_\_\_\_\_

Closer and L\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the objects are, the G\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the force of G\_\_\_\_\_\_\_\_\_\_\_.

31. **Universal Gravitational Formula**

-Every body A\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ every O\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-Formula – Copy this down…

**F** = F\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of G\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (N – Newtons)

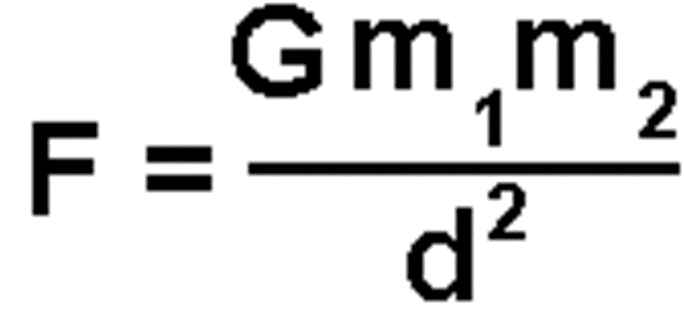
**m1** = Mass of the F\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ object (kg)

**m2** = M\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the Second O\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (kg)

**G** = Gravitational C\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**D** = D\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ between O\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (m)

32. **Universal Gravitation Calculations - Example**

What is the gravitational force between a **100 kg** mass and a **30 kg** mass separated by **2 m**? F = G x \_ kg x kg

22

* F = G \* 3000 F = \_\_\_\_\_\_\_\_\_\_\_ G

4

33. **Precession**

Def: the A\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ T\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ changes over T\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Today, the N\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ faces the North S\_\_\_\_\_\_\_\_\_\_\_ (Polaris)

In many years from now, it will face the star V\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

34. **Why do we have seasons?**

**-**Earth is tilted at \_\_\_\_\_\_\_\_\_ degrees

-March 21 and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: Sun is D\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ overhead (\_\_\_\_\_\_\_/night equal)

-\_\_\_\_\_\_\_\_\_\_ 21: Sun above N\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ H\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (L\_\_\_\_\_\_\_\_\_\_\_\_ days = W\_\_\_\_\_\_\_\_\_\_\_)

-December \_\_\_\_: S\_\_\_\_\_\_\_\_ above Southern H\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Shorter D\_\_\_\_\_\_\_\_\_ = C\_\_\_\_\_\_\_\_\_\_\_)

**Draw:**